approach

AUGUST 1981 THE NAVAL AVIATION SAFETY REVIEW

THINK BLACK

By LCDR A. E. Junker
VA-192

THINK black. Not dark black. Black black – 3,500 feet – night black. Glance left. Black. Glance right. Black. Don't fail me now TACAN, or radio, or compass, or God knows what else.

Think red. Dull red. Instrument glare on the canopy red. Altimeter red. Airspeed red. ADI red. Red needles all whispering a clue. You're on course, you're on altitude. You're flying. Alone.

Think blue. Wild blue, like in yonder. Alone in it, loving it, even when it's black blue.

Think white. Dark white. All by yourself in the clouds at night white. Silent white surrounding your plane from 800 feet to heaven white. Black as hell white.

Think static. How do you hear? No answer but no panic static. NORDO static. A nice luxury failing at night static. Who needs UHF anyhow static.

Think orange. Master caution orange; flashing master caution for a hydraulic failure orange. Orange at night makes black. Think black orange.

Think spinning. TACAN needle spinning. DME spinning. Ceaseless reminder that you're on your own.

Think pink. White off flag in the red lit main ADI pink. Spinning white compass numbers in red light without heading pink. No heading but good relative bearing to the ship on the ADF needle pink. White standby compass tucked in a weird place and hardly visible in the red night light pink.

Think class. You're alone and you're the best of the best class. Think so what class. ADF, NORDO, standby gyro, lousy weather at night at sea class. Find your way to ADF holding and push on time class. Inbound turn but don't trust the wet compass in an angle-of-bank so time for 2 minutes class. Blow the gear and flaps at 2,000 feet on inbound heading and still keep the ADF needle pointed in the right direction class.

Think yellow. Sodium vapor yellow. The ship's lit up like a Christmas tree under the overcast at 800 feet yellow. There's your home in the middle of a black sea yellow.

Think green. Meatball between two datums green. Roger ball, you're looking good cut lights green.

Think black. Airplane chocked and tied, "secure from flight quarters" lights out on the flight deck black. Eyes closed in your rack, glad to be safely back black. Quiet black.

Author's Note – The inspiration for the article is from a short story by Richard Bach called "Think Black." The title is the same, the format is somewhat similar, but the content is original. The original "Think Black" was published by Ziff-Davis Publishing Company in FLYING Magazine, Copyright 1962. ◄

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Harlan Krug painted the Northrop/Vought VTX contender on the cover. Painting courtesy of Northrop Aircraft.

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Flight planning

ATTENTION all pilots and navigators! Are you fully utilizing the new service available at your local Aviation Weather Office? The same people that cheerfully bring to you multicolored Horizontal Weather Depictions with minimum advance notice, en route winds, "D" values (departures from standard atmosphere at a given flight level), destination weather, and severe weather warnings now offer you the very latest and up-to-date system of computer flight planning ever to come out of a Monterey computer bank.

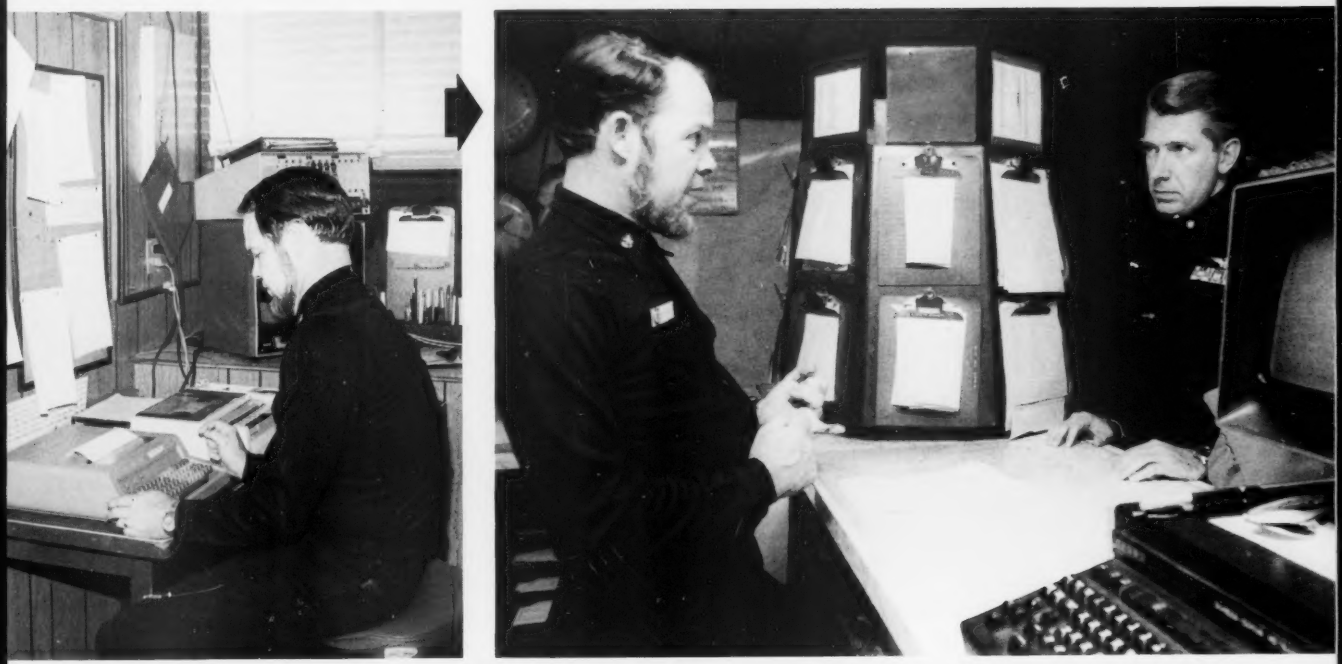
Sound like a sales pitch? You're right. It is a sales pitch. Several years of testing and evaluation have led to the development of the Navy's own computer flight planning system, and guess what? Some members of the aviation community are not really aware of its existence, not sure of what it can and cannot do, dubious of its reliability, or just not yet introduced to the system.

Sure, we've all heard of computer flight plans. That's when the navigator and the forecaster sit down with route charts, weather maps, dividers, and crystal balls and figure out the best route a computer can fly. And sure we've all heard of OPARS (Optimum Path Aircraft Routing System). That's the gadget the weather forecaster uses to tell whose NAS homebase is on an infrared satellite picture of the southeastern United States. If the above describes your feelings regarding computer flight plans, then stand by to take on some new information.

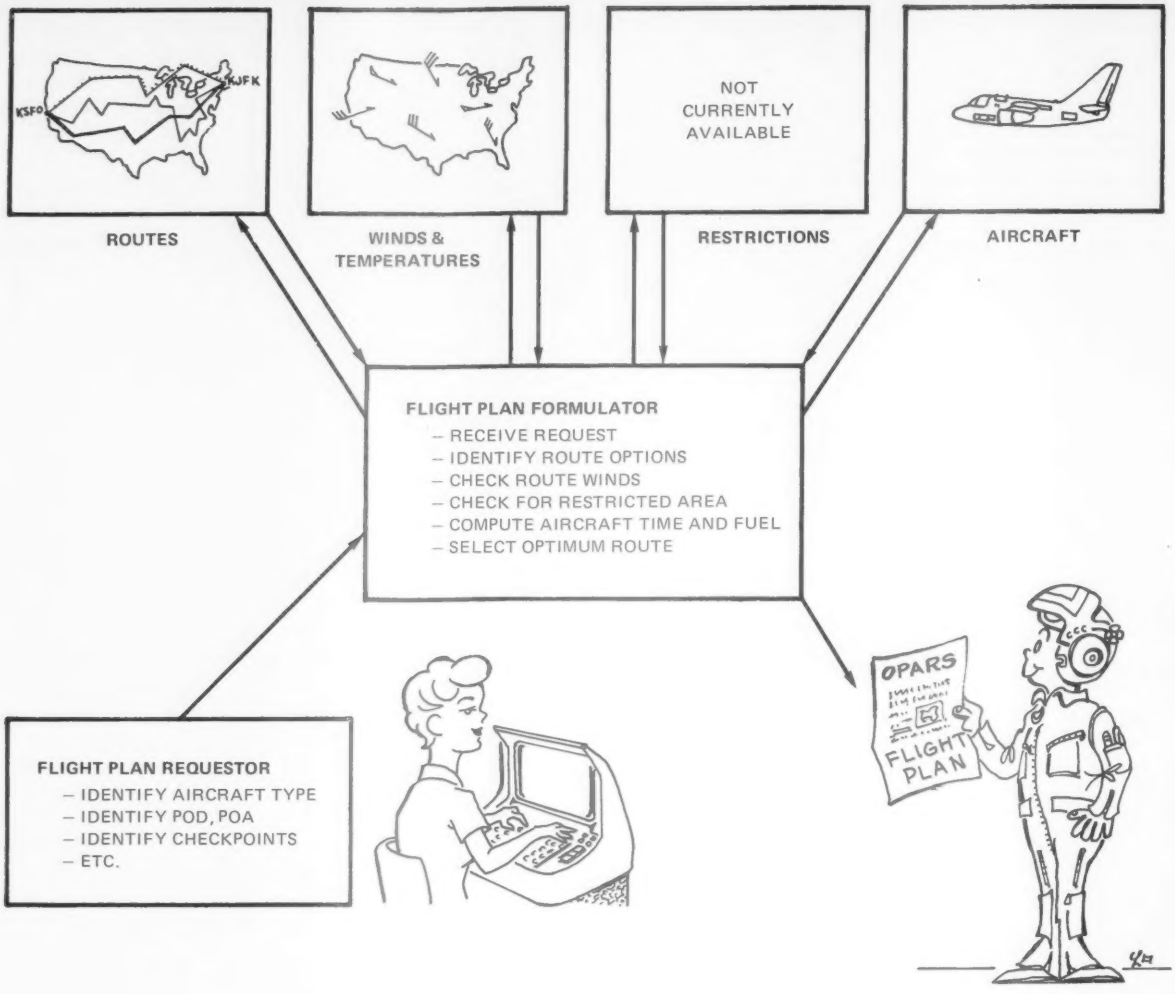
First, let's lay down some groundwork. The Navy and various other organizations in the flying business have been utilizing computers to calculate the most efficient flight plans for a good many years. Fuel efficiency heads the list of the advantages of accurate flight planning. Wind factors are usually the culprit in bad fuel estimates. Computer flight plans can provide the most fuel-efficient route from point A to point B after consideration of the predicted flight level winds, aircraft operating parameters, and proposed routing. Now doesn't that sound simple and efficient? If we stuck to the basics mentioned above, it would be simple and efficient. Several problems arise, however, when we consider the wind fields, operating parameters, flight levels, and other factors as being variable, sometimes to the extreme. Continued

the easy way

By CDR C. R. Miller III and AGCS R. A. Pritchard, NAVEASTOCEANCEN



(Top left) Pilot fills out an OPARS Flight Plan request form at NAS Norfolk NAVOCEANCENDET; (left center) operator types the Flight Plan request into the computer; (lower left) OPARS duty petty officer at FLENUMOCEANCEN, Monterey, CA processes the request and returns the finished product back to the NAS Norfolk mini-terminal; (lower center) the completed flight plan request is received by the operator; (lower right) the OPARS Flight Plan is turned over to the requesting pilot.



TYPICAL OPARS FLIGHT PLAN DATA FLOW
Fig. 1

OPARS is the best solution currently available to the problem of fuel-efficient flight planning. Officially adopted by the Navy on 1 January 1981 and simultaneously replacing Lockheed's Jet Plan, OPARS consists of a set of computer programs to select optimum routes for Navy, Marine Corps, and Coast Guard aircraft in support of flight operations. An optimum route is the selected aircraft path and altitude which is constrained by aircraft performance parameters, winds, flight regulations, and minimum total fuel consumption for the type of flight requested.

The OPARS is comprised of four distinct subsystems, briefly described as follows:

- **Communications** – Provides an interface for the flight plan requestor to generate and submit OPARS requests and for the data base manager to monitor, control, and assist in the flight plan development as required.
- **Flight Planner** – Computes optimum route and performance parameters for each aircraft in support of flight operations.
- **Data Base** – Provides a centralized data base containing aircraft performance, route structure, and other information required for the satisfactory performance of OPARS.
- **Environmental Interface** – Generates an operational, global, environmental data base and provides the flight planner real-time access to and three-dimensional space and time interpolation of this data base.

Figure 1 depicts the functional flow of OPARS during the generation of a flight plan.

The lower left-hand illustration in Fig. 1 represents the Flight Plan Requestor as the individual interacting through a remote terminal linked with the computer system at Fleet Numerical Oceanography Center (FLENUMOCEANCEN) at

Monterey, California. The Flight Plan Requestor builds a flight plan request at the terminal with the aid of a program called the Interactive Request Generator (IRG) and submits the flight plan request to the computer for processing. Included within this request will be such items as aircraft type, point of departure, time of departure, and point of arrival.

After the flight plan request has been submitted to and accepted by the computer system, the Flight Plan Formulator (see Fig. 1) represents the OPARS programs which commence the selection of an optimum route for the aircraft to fly. During this building process, the Flight Plan Formulator will call on different parts of OPARS – route options, wind data, and aircraft parameters. Route options provide numerous different routes that could be used to get from point A to point B. These routes are all checked with wind and aircraft parameters, and the route that takes the least fuel is chosen and returned to the requesting terminal. In some cases, an OPARS terminal may not be available at the requesting site. Procedures have been established whereby sites without OPARS terminals may request unclassified OPARS flight plans directly from FLENUMOCEANCEN via AUTODIN. These procedures are outlined in the current OPARS User's Manual, Fleet Numerical Oceanography Center 3-80, and instructions are available at your nearest Aviation Weather Office.

So how does all this affect you? Again, briefly, OPARS will compute time, distance, and fuel from point to point. With various combinations of optional entries available, you may plan a flight to include a mission leg, two cargo changes, inflight refueling, up to 10 fly-to points, and up to three legs. There are presently 36 Navy, Marine Corps, and Coast Guard OPARS terminal locations that can assist your flight planning (see Fig. 2). Using AUTODIN request and response, OPARS is available at virtually all military installations worldwide. At sites having OPARS terminals onboard, OPARS should be requested a minimum of 3 hours in advance of your ETD. When utilizing AUTODIN, keep in mind that from time of request to time of receipt may take 6 to 8 hours. The objective, of course, is to get an OPARS in your hands before filing your flight plan.

There are a few more suggestions we might add before you run right out and request an OPARS for your next cross-country or "cross-the-pond" flight. NAVOCEANCOM activities providing aviation weather services have OPARS flight plan request/worksheets which they will provide you on request. A few brief moments of your time in going over the options available and the format required with these sheets will pay off in an error-free request. Errors in requests have been the bane of timely and accurate delivery of OPARS flight plans. A standard flight advisory does not contain adequate information to generate an OPARS flight plan. As a rule, NAVOCEANCOM personnel are not sufficiently cognizant in aircraft logistics, navigation, and general flight planning to be able to generate a flight plan. They need help! You as the "flight planner" are the logical source of this help.

NAVY	COAST GUARD
BRUNSWICK, ME	ELIZABETH CITY, NC
SOUTH WEYMOUTH, MA	CLEARWATER, FL
WILLOW GROVE, PA	SACRAMENTO, CA
PATUXENT RIVER, MD	KODIAK, AK
SUITLAND, MD	BARBERS POINT, HI
NORFOLK, VA (LP-1)	
NORFOLK, VA (NEOC)	**MARINE CORPS**
MEMPHIS, TN	CHERRY POINT, NC
CECIL FIELD, FL	EL TORO, SANTA ANA, CA
JACKSONVILLE, FL	
GLENVIEW, IL	**SQUADRONS**
NEW ORLEANS, LA	VRF-31 NORFOLK, VA
WHIDBEY ISLAND, WA	VR-56 NORFOLK, VA
ALAMEDA, CA	VP-30 JACKSONVILLE, FL
MOFFETT FIELD, CA	VR-58 JACKSONVILLE, FL
PMTC POINT MUGU, CA	VP-93 DETROIT, MI
SAN DIEGO, CA	VP-31 MOFFETT FIELD, CA
BARBERS POINT, HI	VR-55 ALAMEDA, CA
MONTEREY, CA (D/O)	VRC-30 SAN DIEGO, CA
MONTEREY, CA (SUPERVISOR)	VR-57 SAN DIEGO, CA

OPARS TERMINAL LOCATIONS
Fig. 2

When requesting an OPARS, be specific in furnishing all the requested information. Routing is especially confusing to most nonaviation personnel. Accurate initial information will preclude your smiling weather person having to give you a completed OPARS that routes you from Norfolk to Bermuda via Dallas. Many canned routes that use most frequently flown tracks are available to users. Selection of one of these routes, when applicable, will save the time of "reinventing the wheel." Other canned routes, developed by your command, may be forwarded to FLENUMOCEANCEN at Monterey for inclusion in the OPARS data base.

It must be stressed that OPARS is not a substitute for the required flight weather forecast (DD Form 175-1) and associated weather briefing services. OPARS, as an environmental support product, should be an integral part of the flight briefing service and should be processed and disseminated by qualified and designated NAVOCEANCOM, Marine Corps, or Coast Guard personnel.

A visit to your Aviation Weather Office will provide the information necessary to plan, submit, and receive an OPARS flight plan for your own evaluation. Try it. It works! ◄

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air breaks

Attaboy Mike and Art! Recently, VT-31 had the opportunity to witness the quality of its product when two students, Ensigns Mike Beauchamp and Art O'Hanian, were confronted with a complicated, abnormal emergency situation.

Both had just completed an initial instrument checkflight, and with the ink barely dry on their instrument cards, the pair departed for NAS Pensacola on the final syllabus flight – an air navigation solo.

While climbing through FL210 in their T-44A, ENS Beauchamp noted the illumination of the fault warning light and, along with it, the left generator light. Several attempts to reset the generator were fruitless, and it was secured. Following recommended NATOPS procedures, a reduction of the electrical load on the remaining generator was accomplished by securing deicing equipment and cabin temperature control systems.

Houston Control was notified and a request made for radar vectors to return to NAS Corpus Christi. A descent was initiated, and shortly thereafter, the fault warning light illuminated again, along with the right generator light. Attempts were made to restore the right generator to proper operation but to no avail. The students now found themselves with electrical power being supplied by only a 24-volt NICAD battery.

Center was notified of the dual generator failure. With power being drained, flight instruments, navigation equipment, and communications equipment began to fail. Center's final clearance to the T-44A to descend to 5,000 feet was barely audible to the pilots.

The two pilots continued their descent from 11,000 feet to 5,000 feet on partial panel in total IMC conditions. Between 5,000 and 6,000 feet, VMC conditions were established and areas of the South Texas coastline were recognized. The pilots flew the aircraft along the coast until a familiar landmark near the NAS was sighted.

Upon arrival at the field, an overhead Delta was flown in order to manually extend the gear. Layered clouds and reduced visibility made it difficult to keep the field in sight. Overhead the duty runway at 1,000 feet, with wings being rocked, the T-44A made a break at the numbers. The tower flashed a green light, and the aircraft was flown to a safe, no-flap landing. The two now-well-experienced pilots turned the aircraft over to maintenance, checked in with the duty office, and asked if there were any more aircraft available. Well done and Attaboy guys!

A Piece of Helmet. A flight of three F-14s completed a routine ACM mission and returned to the carrier.

The flight leader commenced a left break with the wings set at 68 degrees and at 800 feet AGL and 330 KIAS. As the aircraft rolled past 30-45 degrees angle of bank, the pilot attempted to reverse the stick to the right to stop the roll. The stick wouldn't budge. The pilot then applied full right rudder, confirmed the autopilot was off, and hit the paddle switch while applying full force on the stick with both hands to force it to the right. At about 160-170 degrees angle of bank (almost inverted), the controls finally freed and the pilot recovered at 300-500 feet AGL. A normal carrier arrested landing followed.

A subsequent investigation of the aircraft revealed that a broken piece of the pilot's visor cover was lodged in the stick boot. The pilot had known for 2 weeks that his helmet visor cover was cracked, but he considered it functional. Whether the helmet piece had come loose during this flight or an earlier flight could not be determined. The pilot did not remember striking his helmet in the cockpit during the flight, however.

The potential for disaster from this incident is self-evident. While the probability of both the helmet piece separation and the exact positioning of this or other FOD in the stick boot is remote, it must be remembered that it happened in this case. It can happen again in another way.

As the skipper stated, "We were lucky this time but may not be the next time. The case for top quality aviator's equipment and personal attention to its material condition cannot be overstressed. Further, aviators themselves are the final quality control in the maintenance chain in regard to their equipment; we must continue to uphold this responsibility."

P-3 Pitchlocked Prop. The flight was scheduled as a "school run" to depart NAS Barbers Point, make a brief passenger/refueling stop at NAS North Island, and then continue on to RON at Moffett Field. The preflight, brief, engine starts, and taxi were routinely accomplished. As the aircraft approached the hold-short line, the PPC, LT Paul J. L'Heureux, and the Flight Engineer, AD1 Duane Hipperson, were briefed on the normal and emergency procedures for takeoff by LTJG Greg Peterson, who was in the left seat for takeoff.

Max power was set and a normal takeoff roll followed. At rotation speed, LTJG Peterson smoothly raised the nose and the P-3 lifted off the deck. After the gear were retracted, the FE called "Overspeed on No. 3." LT L'Heureux asked the extent of the overspeed and the FE replied "106 percent." The PPC then asked if there were any RPM fluctuations and checked for illumination of either the Prop Pump No. 1 or Prop Pump No. 2 light. The FE verified that the RPM was steady at 106 percent. As he reached for the annunciator panel lights switch to get a quick "lights check" prior to pulling the emergency shutdown handle, the Prop Pump No. 1 light illuminated, followed immediately by the Prop Pump No. 2 light. This indicated a complete loss of controlling hydraulic oil. Procedures for operating with an unfeatherable prop were executed. LT L'Heureux declared an emergency with Honolulu Departure Control and requested a downwind entry to the Delta pattern.

Once set up for pitchlocked propeller operation and in orbit in the Delta pattern, the PPC had LT Scott Lyons, the third pilot on the flight, break out the NATOPS Manual and review the applicable section to ensure proper completion of all emergency procedures. All landing procedures, WARNINGS, CAUTIONS, and NOTES were reviewed. When the flight station crew had been thoroughly briefed on what to expect during the approach and landing, and all were satisfied that they were prepared to handle any anticipated difficulties, LT L'Heureux moved into the left seat and LT Lyons moved into the right seat. Since the aircraft had lightweight gear, the wings were full, and there was no fuel in tank No. 5, dumping fuel was not a possibility. An overweight landing with a pitchlocked, decoupled propeller was anticipated.

The aircraft was flown from the Delta pattern for a 5-mile straight-in approach to the runway. The No. 3 engine was secured with the fuel and ignition switch at 3 miles. After a moderate swerve to the right as the engine decoupled from the propeller, the aircraft was retrimmed and flown to an uneventful, minimum rate of descent, overweight landing. LT L'Heureux and his crew, by reacting in a thoroughly professional manner, kept a serious situation from degenerating into a dangerous one. Well done!

Don't Cover Up Aircraft Damage. During a phase "C" inspection of an E-2B, the starboard propeller was found to have sustained 1½-inch square cuts on the cuff of each blade. The aircraft had flown the previous night. Normal turnaround and daily inspections had been performed with no discrepancies noted on the propeller or engine cowling latches. Aircrew preflight and postflight inspections also failed to note the damaged blade cuffs.

The probable cause of the damage resulted from the forward starboard cowling latch impacting the blade cuffs. When the damage was discovered, the latch was properly fastened. Further investigation revealed that the latch and U-bolt locking bar had also sustained damage. This indicates that the damage probably occurred when the propeller blades were being turned during an inspection.

It's obvious that proper maintenance procedures, turnaround and daily inspections, and aircrew preflight inspections were not the order of the day since the damaged cuffs were readily noticeable. The damage, however, could not have occurred with the cowling latch properly fastened as it was found during the phase "C" inspection. The troubling aspect of this hazard is the probability that the person responsible for the damage refastened the latch after the damage occurred and failed to notify his supervisor. This constitutes gross negligence on the part of the individual involved.

When an aircraft is damaged in any way, those aware of it have the responsibility to make it known to their supervisor. Fear of punitive action or a dressing down should not be considered. The bottom line is that a damaged aircraft can jeopardize the lives of those who man it. Regardless of the scope of damage, it must be reported. ◄

Stick with the

NAVAL aviators are normally known for being good team players – **they stick with the game plan**. Once in a while, however, a player doesn't go by the book, breaks a few rules, and his team ends up on the losing end. The event discussed below is one such example.

The name of the game for this particular flight was an armed (simulated) daytime combat search and rescue exercise (CSAREX). Participants included two H-1 escort aircraft, a photo H-1, a rescue H-3, an aggressor H-3, and A-7 attack aircraft.

The initial mission brief included both fixed-wing and helicopter aircraft commanders. Following this, the rescue helo, aggressor helo, and escort helo crews were briefed on specific intraflight tactics and procedures to be followed. Specific parameters were established in relation to tactics to be employed upon sighting and engagement of the aggressor aircraft. Evasive maneuvers (EVM) were **not** authorized.

We now get to the subject of this article – the H-1 flight leader. During the brief, it was agreed that the copilot would sign for the aircraft and occupy the pilot's right seat even though the flight leader was the assigned PIC on the flight schedule (rule violation No. 1). Since you can't tell the players without a scorecard, we'll continue to refer to the flight leader and copilot as such throughout the remainder of the contest.

The H-1 was preflighted and the crew manned the aircraft. Following takeoff, a nap-of-the-earth (NOE) power check was conducted since the aircraft was operating at a high elevation. After communications were established with the H-3 rescue helo, a rendezvous was effected and the CSAREX commenced.

Much of the ingress to the survivor was conducted with one H-1 escort in the lead and the other trailing the rescue helo. Upon arrival at the landing zone, the H-3 took the lead and one H-1 swept in to clear the area. The two H-1s then entered their protective pattern while the H-3 picked up the survivor. It was a particularly swift pickup, and the flight began its egress towards the southwest.

During egress, the flight leader's H-1 escort was caught in a bad position and trailed the other two helos by one-quarter to one-half mile. At this time, the aggressor helo was spotted about 2 miles to the northwest. The flight leader directed the two other helos away from the aggressor, and his H-1 commenced what was briefed to be a simulated gun and rocket attack on that aircraft. Once the engagement began, minimum closure was to be 500 feet with a left-to-left pass. As stated earlier, no EVM was authorized.

The H-1 came around a hill heading for a ridge, with the flight leader anticipating that the aggressor H-3 would be coming around the other side of the hill. He was right. When the H-3 emerged, it had closed to within a mile of the *Huey*. The H-1 then crossed the ridge heading southwest towards the west end of a bowl. At this point, the flight leader took control of the H-1 and made a left turn into the bowl. The flight leader had intended to make a turn in the bowl that would enable him to get his aircraft relatively close to the aggressor at the 90-degree position as he crossed the ridge. Unfortunately, he misjudged the distance and was not in position as planned but was still in a left turn at the east end of the bowl. The H-3 spotted the H-1 and commenced a left turn. The H-1 flight leader then turned toward the aggressor to make a simulated rocket salvo run. The run was made at about 65 KIAS, and the H-1 passed over the top of the H-3, some 75 feet above him. The H-3 then turned left, and the flight leader also turned left to get into an in-trail or tail-chase position. This constituted evasive maneuvering (rule violation No. 2).

Since the H-3 was also in a left turn, the flight leader had to put the H-1 in a steep bank to acquire the position he desired. During the turn, he realized he was losing airspeed. He rolled out of the turn at an altitude between 150 and 200 feet above the ground and applied forward cyclic to trade some altitude for airspeed. But it just wasn't his day! His ground closure rate was too great, and the H-1 contacted the ground in an area where the terrain sloped up. The helo then bounced back into the air. For a moment, the flight leader thought the impact hadn't been too bad and that the aircraft was flyable. Not so! Shortly after impact, the low RPM audio was heard, and it became apparent the *Huey* would not fly again that day. The aircraft was at an altitude of between 25-30 feet, which was insufficient to lower the collective, and rotor RPM was inadequate to cushion the landing. The H-1 impacted the ground with quite a force, in a nearly level attitude, with very little forward momentum.

The mishap resulted in injuries to the copilot (back fractures) and one of the crewmen (a fractured right ankle). Aircraft damage was estimated at over $200,000.

The flight leader was a senior naval aviator who, in the past, had shown no inclination to violate rules and regulations. Yet, on this day, he violated two. He allowed a copilot who was not the PIC to sign for the aircraft and, in fact, perform a mission for which he was not qualified. He then participated in EVM – specifically prohibited for this flight. Once the flight leader closed the aggressor helo inside the briefed aircraft separation limitations and began an offensive or defensive maneuver, he was in an EVM environment, a regime of flight for which he had no experience and no training.

game plan

By Russ Forbush
APPROACH Writer

The flight leader allowed the excitement of the mission to blur his normal good judgment. There were opportunities for him to avoid the engagement or terminate after the initial intercept, but he failed to do so. Once in the EVM environment, he pressed himself and his aircraft too far, and the mishap resulted.

If the flight had been executed as briefed, it would have been good, safe training. It was neither. The lesson to be learned is – if you're going to play the game, stick with the game plan. ◄

B

BRAVO

CDR Joe Arcari, AW2 Tim Cates, LT Terry Mahoney

OCCASIONALLY a NATOPS flightcheck turns out to be more than the crew bargained for. This happened recently to an HSL-36 crew in their SH-2F. CDR Joe Arcari (HAC), LT Terry Mahoney (copilot), and AW2 Tim Cates (crewman) had completed the first half of a 5-hour flight, hot-refueled at Mayport, and departed on the second half of their NATOPS flight.

The AC noted that the wind was too strong for normal pattern work and departed the airport traffic area to perform doppler approaches, SSC (ship surveillance contact), and radar work off the coast. During the flight, the crew picked up a radar contact and commenced a radar run on the contact. When they were 2 miles from the beach, the crew heard a loud bang, followed by a severe medium frequency vibration in the airframe. It was worse than either pilot had ever experienced. LT Mahoney, who was at the controls, immediately turned into the wind. CDR Arcari took control, and LT Mahoney commenced going over the ditching checklist. AW2 Cates readied the liferafts and secured the aft cabin.

CDR Arcari initially felt that a ditching was imminent. However, with the helo under control but vibrating badly, he decided to make an approach to the beach a mile and a half away. A Mayday was broadcast to Mayport Tower and a gradual descent was initiated. CDR Arcari correctly surmised that he had a failure somewhere in the tail rotor drive train. Cockpit gages were blurred from the vibrations but appeared normal. The caution light board was clear. Control movements were kept to a minimum, with the crew poised for an immediate ditching if necessary.

The area selected for landing was near several resort hotels, but an unpopulated area above the high water line was found. Once the beach was made, the landing gear were lowered and the emergency landing was accomplished.

As crewman Cates exited to pin the gear, he noticed the tail rotor gearbox was bouncing from side to side. He signaled the pilots to shut down the engines. Because of the severity of the vibrations, it took both pilots on the controls before the engines could be secured and the rotor brake applied.

One of the four tail rotor blades had sheared at the shank, leaving 8 inches of jagged blade. The tail rotor gearbox was hanging askew, attached by only one of four retaining bolts.

The professionalism of the crew, their knowledge of the aircraft, and the fact that they were able to land on dry land vice the water saved a valuable aircraft from loss and averted any personal injury.

LCDR C. D. Englehardt

LCDR C. D. Englehardt of VA-22 was descending through 3,000 feet at .75 mach in his A-7E with the throttle at a high setting. He experienced a sudden loss of thrust, accompanied by a rapid reduction of fuel flow to 1,800 pph and RPM decay to 80 percent. No advisory or caution lights were illuminated. Engine response was normal with the throttle in the low power range. The RPM and fuel flow indications did not vary with throttle movement above the 80-percent throttle position. His closest divert field, Wake Island, was 25 miles away.

Fuel flow increased to 2,300 pph and RPM to 82 percent when he switched to manual fuel control. He used his excess airspeed to climb to 3,800 feet. However, he was unable to maintain altitude and had to settle for a 300-500 fpm rate of descent. All external stores were salvo jettisoned except for one live AIM-9L and 2,000 pounds of fuel was dumped from the wing tank. Internal fuel indicated 4,000 pounds. He executed a textbook precautionary approach, landing safely at Wake Island. He had absolutely no waveoff capability.

Maintenance discovered a loose connection on the high-pressure shutoff valve linkage to the valve shaft which allowed the valve to vibrate partially closed without commanded linkage movement. Had it closed any further, a flameout probably would have occurred.

After the A-7 returned to the carrier, 20 other air wing A-7s were inspected for the same discrepancy. Seven had bolt/nut assemblies attaching the linkage to the high-pressure shutoff valve shaft which were properly torqued, three were overtorqued, nine were undertorqued, and on one, the bolt was only finger-tight.

The air wing commander commented: "In view of the recent A-7 accidents related to suspected fuel supply problems, this incident exposes an additional failure mode possibility that should be inspected and investigated. Only the extreme good fortune of the proximity of a divert field and the highly professional performance of LCDR Englehardt prevented the loss of this aircraft. Had the aircraft not been recovered, it is very unlikely that the failure of the high-pressure fuel shutoff linkage would have even been considered as a probable cause factor. With one linkage slipping, one loose, and 11 others improperly torqued, it is worth considering this hazard as a possible cause of previous A-7E accidents involving thrust loss/flameout." ◄

Out-of-control flight:

A USER'S POINT OF VIEW

By LCDR Mike Szoka
VF-126

"If I depart the F-14, I'll push the stick forward, neutral laterally, and get the rudder in opposite the yaw. I'll put the throttles at military if they are not stalled..."

As a part of the Rules of Engagement, the out-of-control recovery procedures for each type aircraft involved are discussed prior to each Air Combat Maneuvering (ACM) sortie in Fighter Airborne Early Warning Wing Pacific. Have you ever wondered how the person reciting the procedures will actually react in an out-of-control situation? I have.

I am strongly convinced that unless you have your plan firmly entrenched in your mind and are fully prepared to execute it under duress, your chances of recovering your aircraft from an out-of-control situation are greatly reduced, especially if the departure and poststall gyrations are allowed to progress into a fully developed spin. As the director of the VF-126 T-2C Out-of-Control Program, I've flown my share of spin hops, and one fact seems to bear itself out. Out-of-control flight, even under training conditions, can be startling and disorienting to even the most experienced aviators.

The first and most important thing you must do in any out-of-control situation is to neutralize all controls and attempt to reduce the angle-of-attack (AOA). The best method of recovering from a spin is to avoid it in the first place. To spin, an aircraft must be fully stalled and yaw must be introduced. By neutralizing lateral control inputs and ensuring that your engines are not producing asymmetric thrust, you generally can prevent a yaw buildup at the stall. Simply releasing aft stick pressure in most cases (a few aircraft do require forward stick) will allow the angle-of-attack to decrease below stall AOA. At this point the aircraft should fly itself out of the stall, and you'll be back in the fight as soon as you get your airspeed up.

Should the aircraft progress past the stall point and into the departure and poststall gyration phases, things become a little more complicated. I mentioned duress earlier; out-of-control flight is an *extremis* situation as has been proven in recent years by the number of aircraft and lives that have been lost due to stalls, departures, and spins. In any emergency, the adrenaline begins to flow, your mind works faster, and time seems to expand. In fact, evidence extracted from actual data traces taken from test pilots during spin flights has shown that time seems to expand by a factor of five (e.g., if you think that you have had controls in for 25 seconds, in reality they've only been in for about 5 seconds). Why is this important to know? There are two areas of out-of-control recovery in which patience is extremely important, the first of which is during the poststall gyration phase. It is very difficult to hold neutral controls while the airplane is flopping around like a fish out of water. It is natural to try and help the airplane fly again.

All aircraft have some basic actions that should be accomplished as soon after the departure as possible. Checking such items as engines, trim, flaps, spin assist, etc., in addition to serving aerodynamic purposes, gives you something to do with your hands and mind while maintaining neutral controls. Once your left hand has done everything it has to do, there's no place to put it except on the stick. You'll need it there later!

Now it's time to start looking at some instruments. The first and most important item to check is the altimeter. Hopefully, you had some idea where you started your maneuvering, so this shouldn't be a complete surprise. If the altimeter says 10,000 feet, you are rapidly progressing toward the last step in the boldface procedures. On the other hand, if Mickey's little hand is on 20,000 feet, you've got 20 to 30 seconds to enjoy the ride.

RIOs, BNs, and ECMOs – the altimeter is your primary scan. Remember, if nothing else works, the altimeter will save your life! If the aircraft continues to act more like a gyroscope than a flying machine, it's time to make a determination: Am I spinning? The angle-of-attack gage will tell you the mode –

upright or inverted. So you think it will be intuitively obvious whether you're upright or inverted! Well, the translational, eyeball-out G of a flattened upright spin is very similar to the negative G of an inverted spin, so look at the gage. The turn needle will tell you the direction. No matter what your mind tells you, believe the turn needle. Finally, the airspeed indicator will make the final "yes" or "no" determination. If the airspeed is low and constant or fluctuating about some constant value and the AOA and turn needle are pegged, it would be a pretty safe bet to say you are spinning. If, on the other hand, you see 200 KIAS on the airspeed indicator, no matter what the AOA and turn needle say, you are not spinning. No Navy tactical aircraft spins at an airspeed in excess of 200 knots.

Once you've positively determined that you are spinning, now and only now is the time to apply anti-spin controls. Apply the controls positively and completely to the stops. (It's much easier to do with both hands on the stick.)

Now that you have the spin recovery controls in, you must again exercise a great deal of patience. Remember that it takes time for the aerodynamic forces of the recovery controls to overcome the inertia of the spinning aircraft.

Once you have applied the spin recovery controls, there is nothing more for you to do inside the cockpit except scan the altimeter. You must look outside to see the recovery. You will not pick it up on the gages due to instrument lag. As soon as the rotation stops, neutralize the controls. If you don't neutralize, you may enter a progressive departure because your anti-spin controls now become pro-spin controls in the opposite direction. (There is one exception to this, and that is the hesitant inverted mode in the A-4. Wait until the rotation has stopped and the airspeed is increasing through 180 knots before neutralizing.)

Should the aircraft enter a progressive departure, maintain neutral controls and check the instruments. Do not automatically swap the controls! Aerodynamically, an aircraft cannot progress from spinning in one direction to spinning in the opposite direction instantaneously. It must pass through the stall, departure, and poststall gyration phases. The recovery procedure for each of these phases is neutral controls. In looking at the airspeed indicator, you'll probably be pleasantly surprised to see that the aircraft is merely doing recovery rolls with increasing airspeed. Chances are slim that the aircraft will enter a spin in the opposite direction.

After the spin has stopped, you still have a couple more things to do; you're not out of the woods yet! Now you must recover from the dive. You'll find yourself approaching the ground at a high rate, and the most effective way to recover is to use the angle-of-attack. Most aircraft NATOPS manuals specify an optimum angle-of-attack or G-loading for the dive recovery.

In most aircraft, after the dive recovery, the fight is over. However, a few aircraft will require that you go on to another emergency procedure – that of an airstart.

An aviator can usually recover from any excursions into the region of the charts known as uncontrolled flight by neutralizing all controls at the stall or departure point. If the altimeter says you have time, the AOA gives a mode, the turn needle gives you a direction, and the airspeed indicator says "yes," apply and hold recovery controls.

In 2 years as an out-of-control flight instructor, I have watched fleet aviators do a lot of strange things in a controlled, sterile situation. Remember the saying "You fight like you train"? The time to formulate your plan is not the first time that you unexpectedly encounter uncontrolled flight. Construct your plan of attack **now** and be prepared to flawlessly accomplish every step before you encounter a dynamic, disorienting situation. ◄

MISSILE HAZARD

By LCDR Dave Ersek
VAW-114

TAKE a recent double cycle off the coast of California in an E-2 *Hawkeye*. Add boredom with all indications inside the aircraft normal. Spice with a fair pass to a number 3 wire and what do you have? A missile hazard! How?

Well, it's about the 8-pound, international orange HF trailing wire drogue (weight, if you will) with 150 feet of wire attached that often exhibits a mind of its own. On this day, it departed the aircraft on arrestment and bounced along the flight deck at 105 knots just waiting for someone (or something) to get in its way. The elaborate warning indicators in the aircraft that tell the crew this might happen failed to indicate . . . as they have before and will again.

The moral of this little story is simple. At least once during a cruise an E-2 will probably lose one of these little beauties during a cat shot or a trap, and woe be to the person or thing unaware of its random wanderings. Even if the crew knows there is a problem, they may be helpless to do anything about it other than inform the flight deck of the possible missile hazard.

The cures for this possible permanent headache are awareness (which I hope you have now) and keeping your head on a swivel while on the flight deck.

Hold that checklist!

By LT Chip Youngblade
VP-23

IT was obvious to the flightcrew that something was amiss as the P-3C, at near max gross weight, struggled off the runway from NAS Northland en route to a long ASW patrol. As the mainmounts left the runway, the *Orion* started to settle, causing the third pilot, flying from the left seat, to pull the nose to an unusually high attitude. A quick scan by the PPC in the right seat confirmed that all four engines were producing maximum horsepower and that aircraft rotation had begun at the proper speed. With visions of a scraped tail, scraped sono receivers or worse running through his head, the PPC warned his copilot not to overrotate, convinced that this must surely be the cause of the aircraft's abnormal performance. As the aircraft continued to accelerate, the nose attitude became more *normal*, and a still puzzled flightcrew started the climb checklist. Reaching item 2 on the checklist, the PPC called out "flaps" and started reaching for the flap handle which would normally be in the Takeoff/Approach position. He stopped short, however, as he glanced at the flap position indicator. "Indicate up!" was the reply, and a somewhat embarrassed crew continued on their mission.

Let's go back to the chocks. The preflight was normal enough, considering the gusty winds and intermittent snow showers passing through. A last-minute discovery of a low mainmount strut started the ball rolling as difficulties were experienced in obtaining a nitrogen cart and towing it through the drifting snow. By the time the mainmount was serviced, it was 25 minutes past takeoff time. The crew, wanting to keep their delay to a minimum, expeditiously started engines and began their taxi. When the item "flaps" was called out on the before-start checklist, the PPC properly decided to leave them up as NATOPS suggests for taxi evolutions in snow and ice. When "flaps" was called out on the takeoff checklist, the aircraft still had some distance to go to reach the hold-short line, and the PPC elected to leave the flaps up in accordance with NATOPS procedures for the taxiway conditions. However, he continued the checklist, thinking the crew would surely remember the passed-over item.

While the rest of the checklist was being completed, the aircraft was cleared to position and hold. Shortly thereafter, takeoff clearance was received. The PPC informed the tower that due to a passing snowshower, the field was below his takeoff minimums, and he requested a delay until the storm passed through. A civilian tower controller stated that the last half of the runway was VMC but permitted the aircraft to hold its position. Shortly thereafter, a break in the storm afforded the crew a safe takeoff. With the takeoff checklist complete (or so the crew thought), the takeoff roll began, and the aforementioned drama ensued. Fortunately, the only damage was to the flightcrew's egos.

The lesson learned is important. Checklists must be completed step by step, with no steps bypassed. If an item has yet to be completed, **hold the checklist!** This is especially true for a squadron operating in a harsh winter environment; holding the flaps to avoid ice buildup is a classic setup that can only be avoided by using checklists the way they are intended to be used. Let's make this the last no-flap takeoff in the VP community!

The 'eyes' have it —

Fig. 1(a). Daylight 20/20 vision.

Fig. 1(b). Daylight 20/30 vision.

Fig. 1(c). Daylight 20/40 vision. Previously considered adequate for flight deck personnel.

Fig. 1(d) (below). Daylight 20/50 vision.

"WHAT difference does it make if I see 20/20, 20/30, or 20/40?! I see good enough! It's nobody's business but my own! Besides, glasses are a pain! They don't make all that much difference. They're always dirty or falling off. They reduce my peripheral vision (Ha! Now there's a 'safety' item!). Besides, I can't get a good fit for my *Mickey Mouse ears* or my goggles when I wear them (another 'safety' item)!"

Sound familiar? You betcha! We've heard them all. Most of what our friend says is at least partially true, except for two glaring discrepancies. It's everyone's business how well our people can or cannot see, especially when we're talking about final checkers, mechs, QA personnel, etc. Just about everyone requires good vision when working around aircraft. The Navy has taken care of this important issue for aviators by issuing prompt, swift, and almost foolproof legislation. But what about the ground-pounders? Does a guy who sees 20/40 or even 20/30 see well enough to properly check an aircraft? What happens at dusk or at night to a person with marginal eyesight? What about color vision? How important is that for the flight deck? Never really thought about it, have you?

The Naval Safety Center became very much involved in the controversy several years ago when the Navy lost an F-14 off a carrier because the launch bar wasn't properly seated. The checker hooked it up and looked back over his shoulder to doublecheck that it was in place while he cleared the area. It was dusk. The postmishap investigation found that the individual simply could not have seen the position of the launch bar as he ran away. His eyesight was deficient! He had been issued a prescription for eyeglasses before reporting aboard, but for whatever reason, he neglected to have the prescription filled. We consequently checked the visual requirements for enlisted personnel working the flight deck. The requirements were many and varied, depending on rating and job. This was true not only for visual acuity requirements but also for color vision requirements. It was also found that there was little control over who needed glasses or whether they were wearing their lenses or not. As a result of that mishap, word was passed down that anyone working the flight deck must have at least 20/40 uncorrected vision or must wear suitable lenses. This was felt to be sufficient for flight deck requirements, but is it? We'll let you make your own decision. As they say, a picture is worth a thousand words.

Figure 1(a) shows a launch bar (see arrow) at 20/20 vision. Just the way it should look, right? Figure 1(b) shows it with 20/30 vision; Fig 1(c) with 20/40 vision; and Fig 1(d) with 20/50 vision. Please remember that these photos were taken on a clear day, only 20 feet from the aircraft, with full sun (no clouds or shadows). What difference does that make? Quite a bit! Remember, we lost the F-14 at dusk. It has been determined that a person with 20/40 vision by day will have less than 20/100 visual acuity at night. He also requires considerably more light than a person with 20/20 vision to see hazards. (This is because the pupil of the eye normally is much larger under unfavorable light conditions. As such, more nonparallel, divergent light rays are accepted than with a smaller pupil

dilation. This is why myopics (nearsighted people) squint to see better – to make the pupil smaller so fewer divergent light rays are admitted.) As much as 100 times more light might be required for a person with 20/40 daytime vision as for a person with 20/20 daytime vision. In other words, having 20/40 daytime vision cuts one's normal vision in half during the day, but by 90 percent at night, and that's significant!

Take a look at Figs. 2(a), (b), (c), and (d). These figures represent what a person with defective vision will see at dusk or night. "But a person with poor eyesight compensates," you say. Sure he does! A person with poor vision can compensate to a certain extent by "training" his brain to see what it really doesn't. (There usually is a certain amount of lens [of the eye] reactivity, although this varies from person to person. In the "average" individual, perhaps the 20/30 night vision photo would correspond to a person with 20/40 vision.) But refer back to the photos again. Take (c) in Figs. 1 and 2 (termed by many to be "acceptable"). Is someone really able to compensate enough?

What about color-defective personnel? Studies in the automobile industry have shown that color-defective people (unable to **clearly** distinguish between certain colors – 7 percent of males) require twice as long to recognize and to act on signal lights as do people with normal color perception. There exists the possibility for confusion and wrong judgment, in addition to a longer perception time. Color coding cannot be used for color-blind individuals (unable to distinguish between certain colors – 2 percent of the male population) to convey information. It's as simple as that.

What has the Navy done to ensure good visual acuity on the flight deck? BUMED has recently come out with the requirement that those who are in "critical" jobs (e.g., director, spotter, checker, or such personnel as may be designated by competent authority) have 20/20 (corrected) vision, normal color vision, and adequate depth perception.

The next complaint was that the black plastic, thick-framed glasses did not properly fit under the *Mickey Mouse ears* or the flight deck goggles. BUMED has authorized that "comfort cable" aviation frames be used for those working the flight deck. The loss of peripheral vision, along with the other problems associated with wearing eyeglasses, are minimized by using the aviation frames. After all, NFOs have been flying well with eyeglasses for years.

Then again, with improper supervision, we'll keep getting mishap reports that say: "The tow tractor driver has uncorrected vision of 20/70 and 20/100 from an eye exam conducted 6 months prior to mishap and had glasses prescribed to correct this to 20/20. The glasses were not being worn at the time of the mishap." ◄

Author's Note: All photos taken under the supervision of CDR Veckarelli, MSC, USN, Naval Regional Medical Center, Portsmouth, VA. Photos were taken by LCDR Ric French, USN, Safety Education and Training Department, Naval Safety Center, Norfolk, VA.

or do they?

By CDR V. M. Voge, MC
Naval Safety Center

Fig. 2(a). Dusk or nighttime 20/20 visual acuity.

Fig. 2(b). Dusk or nighttime 20/30 visual acuity.

Fig 2(c). Dusk or nighttime 20/40 visual acuity. Equivalent to less than 20/100 daylight vision. Fig. 2(d) (below). Dusk or nighttime 20/50 visual acuity.

FIELD ARRESTING GEAR

By Mr. Richard A. Eldridge
APPROACH Contributing Editor

F-8C arrestment using the E-5 chain gear in 1965

TODAY's field arresting gear installations are quite sophisticated and a far cry from early installations when they were a new and untried innovation. The need for a method to arrest jet aircraft with high landing speeds was recognized back in 1948 when jet aircraft were first being introduced into tactical squadrons.

Correspondence from the Naval Air Test Center at Patuxent River, Maryland, dated 31 August 1948, referred to a chain-type gear which had been installed at that base: "A unique but highly effective emergency arresting facility was added to the standard equipment of Flight Test in July. The prospective arrival of the F7U aircraft, a high-speed carrier fighter plane, created the need for an arresting gear capable of handling the load imposed in the event of hydraulic failure which would result in loss of wing flaps and wheel brakes. The initial flight testing of the F7U was planned to be held at Patuxent River instead of Muroc, California, and some emergency provision for arresting the plane had to be ready in order to reduce the possibility of damage to the first test airplane. Calculations and tests were made which resulted in the installation of 1,500 feet of small anchor chain (12 pounds per foot of length) along each side of Runway 31. Connecting the two downwind ends of the chain are wire pendants which engage the hook of the plane to be arrested. As the airplane moves upwind along the runway, it drags increasing lengths of the chain behind it and is brought to a smooth halt without undue shock or deceleration. Test of the equipment by an F7F (Tigercat) airplane was highly successful."

As jet aircraft started to replace piston aircraft in air groups, it was obvious that there was an immediate requirement for a system to arrest jets with landing emergencies where normal deceleration wasn't possible. Therefore, OPNAV initiated a program to develop emergency arresting gear. Because of its economy and simplicity, the chain drag system was advocated for emergency arrests. At first, tests were carried out using concrete blocks in lieu of anchor chain, which was believed to be in short supply. However, it was found that used chain, which no longer met the minimum

Chart of U. S. Navy Arresting Gear

(Showing Air Force Designations of Equivalent Gear)

USN Designation	USAF Designation	Remarks
E-5/MA-1A	MA-1A (modified)	Unidirectional, nylon barrier between stanchions combined with pendant type cable and attached to chain type arresting gear.
E-5/E-5-1		Chain type.
E-15/E-15-1	BAK-9	Two E-27 arresting gears, bidirectional.
E-27/E-27-1	BAK-9	Rotary friction brake, bidirectional.
E-28	BAK-13	Rotary, hydraulic, bidirectional rotary.
M-21		Hydraulic operational arrester, short runout, bidirectional.

Chart 1

specifications for anchor chain, was available and could be effectively used for arresting gear. Since the chain was available, less expensive, and more durable, the use of concrete blocks was abandoned.

An emergency arresting gear bulletin was issued to advise all air stations of the approved techniques for installing and operating anchor chain emergency arresting gear. Information received from air stations which had independently used anchor chain gear with some success was incorporated in the bulletin. A distribution list called "SI RAG" (Ship Installation Runway Arresting Gear) was established and included all airfields where such emergency arresting gear could be used advantageously. The air stations and facilities also cooperated in providing information on emergency arrests as they occurred. This information was compiled and resulted in the issuance of additional Runway Arresting Gear Bulletins which detailed modifications to chain gear in order to improve performance.

The first Bureau of Aeronautics publication dealing with the emergency chain-type arresting gear was dated October 1952. In 1952, the majority of the installations provided chain weights of 12-15 pounds per foot. Bulletin Number 7, appearing in mid-1958, advised airfields operating the A3D to use a chain weight averaging 60 pounds per foot.

The descriptions of current airfield arresting gear that follow provide a brief glimpse at the evolution of this important but often taken for granted equipment. Chart 1 gives Navy and Air Force nomenclature for arresting gear.

DESCRIPTIONS OF ARRESTING GEAR INSTALLATIONS

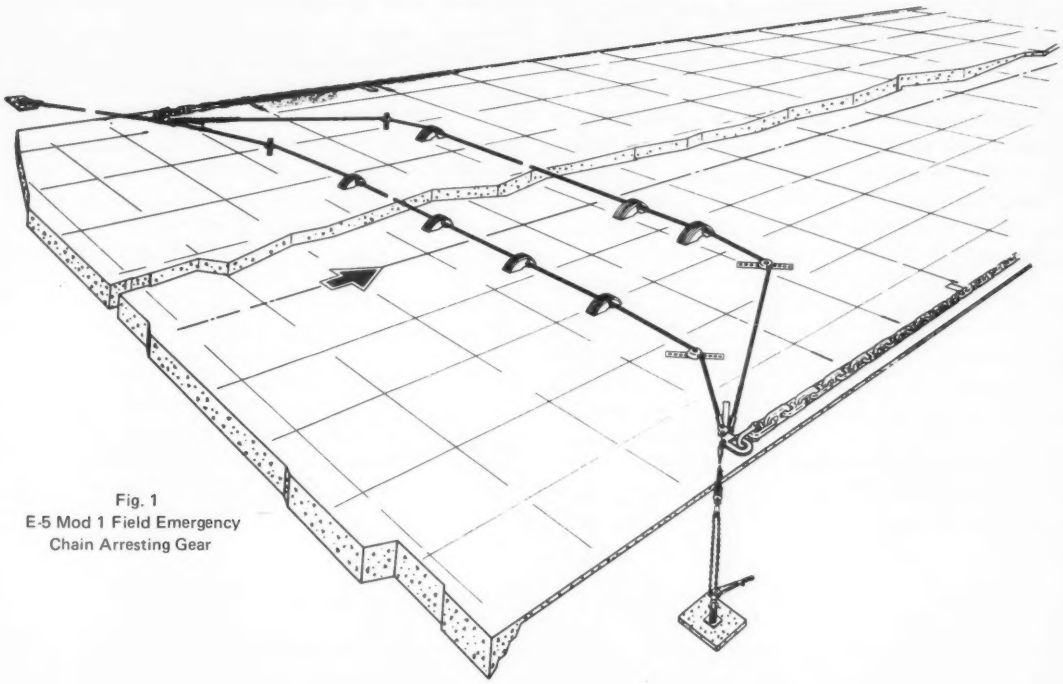


Fig. 1
E-5 Mod 1 Field Emergency Chain Arresting Gear

E-5/E-5-1 Field Emergency Arresting Gear (Chain Type). The E-5 and E-5-1 emergency chain arresting gear equipment consists of dual arresting cable installations for either single or bidirectional emergency arrestments of aircraft. Bidirectional chain arresting gears are designed so that arresting cables may be attached at either end of the chains. The heaviest chain weights are located in the middle at the center of the runway. Only one pair of cables may be rigged at a time, depending on the direction of arrestment.

The E-5-1 gear has two (dual) arresting cables but differs from the E-5 in that the cables are "shaped" pendants of different lengths stretched across the runway. Maximum engaging speed for the E-5-1 is 165 knots for on-center engagements.

The E-5 gear has two (dual) arresting cables consisting of pendants stretched straight across the runway. Maximum engaging speed for the E-5 is 150 knots for on-center engagements.

Off-center engagements for both the E-5 and E-5-1 exceeding one-quarter of the runway span may result in cable failure or the aircraft running off the runway.

The principle of operation for both types of chain gear is having the arresting cables, when picked up by the tailhook, transmit the energy of the moving aircraft to the two anchor chains. The chains are so arranged that they pay out gradually, progressively increasing the weight pickup.

Energy is gradually dissipated by the chain weight pickup until arrestment is completed.

E-5/MA-1A Arresting Gear/Jet Barrier. The E-5 arresting gear, described above, is combined with a runway barrier (MA-1A) which is a modification of the old barrier installation aboard carriers adapted for runway use (see Fig. 2). The barrier consists of nylon webbing which, when engaged by the aircraft's nosewheel, throws an arresting cable upward to engage the aircraft's main landing gear. The cable then pulls out links of heavy anchor chain until the weight of the chain stops the aircraft.

The barrier is less reliable than the pendant type gear and causes some damage to the undercarriage of the arrested aircraft. The prime advantage of the barrier type gear is its ability to arrest hookless jet aircraft. Its authorized use is limited to hookless aircraft or aircraft with hook malfunctions. It has a maximum engaging speed of 140 knots.

E-15 and E-27(USAF BAK-9) Runway Arresting Gear. These two types of arresting gear are designed as emergency standby gear for tailhook-equipped aircraft. The E-15 is an above-deck MOREST installation. The E-27 (BAK-9) can be installed either as an above-ground MOREST installation or below ground as a pit installation. The arresting engine is identical for all three sets of arresting gear. The various designations described below signify a difference in either quantity of engines used, the installation configuration, or both.

The arrestment is accomplished by the engagement of the tailhook with a deck pendant. Aircraft energy is absorbed in the rotary friction arresting gear during runout. The arresting gear consists of two tape storage reels and aircraft disc brakes mounted on a common shaft. The reel and shaft assembly is mounted on a steel weldment frame which also supports the hydraulic control system on one side and the retraction equipment on the other side.

E-27(BAK-9) Above-Deck MOREST Installation. Two arresting engines installed on opposite sides of the runway and operating with a single nylon tape from each engine comprise this installation. Each engine is attached independently above deck to the crossdeck pendant. In both engines, the hydraulic line to one of the two reel brakes is made inoperative to accommodate the single-tape requirements of this type gear.

E-15(BAK-9) Above-Deck MOREST Installation. This installation consists of two E-27(BAK-9) arresting engines installed as diagonal opposites. The engines are attached in parallel to one crossdeck pendant without crossing under the runway to make connections on the opposite side. After an arrestment, the E-15 can be reset by one person in about 5 minutes.

Single E-27(BAK-9) Pit Installation. This installation consists of a single pit-installed arresting engine operating with two nylon tapes. The tape from one reel is coupled to a crossdeck pendant in a conventional manner; the tape from the other reel is routed under the runway and coupled to the

Type MA-1A Runway Overrun Barrier combined with Pendant Type Arresting Gear

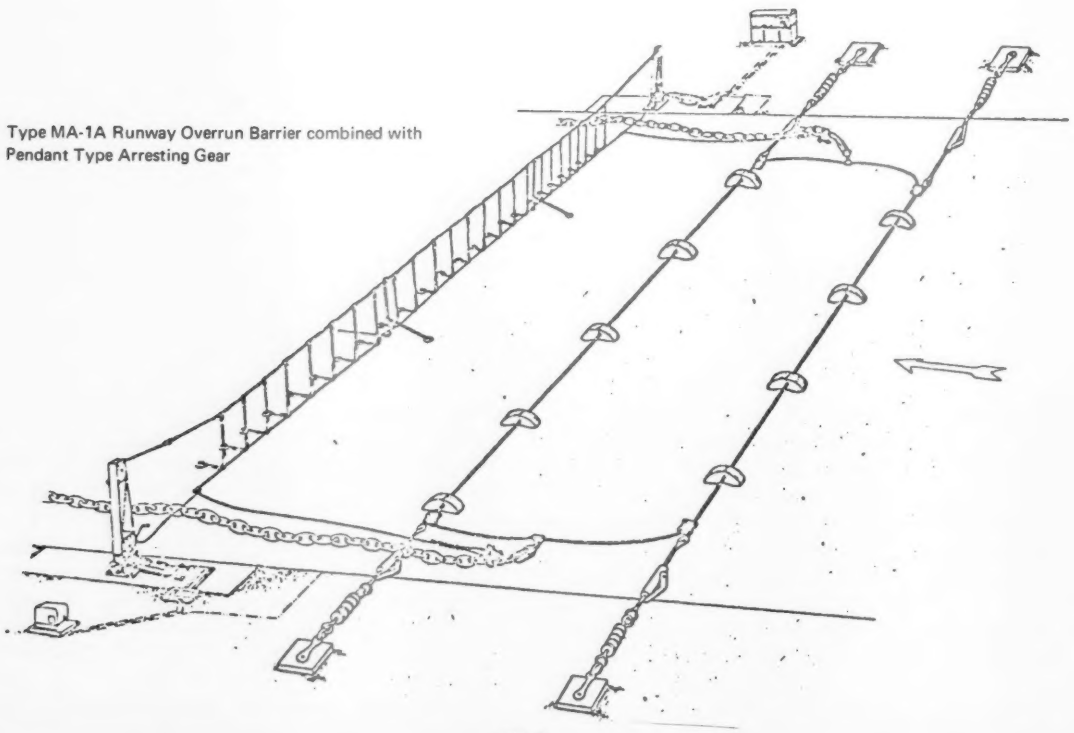
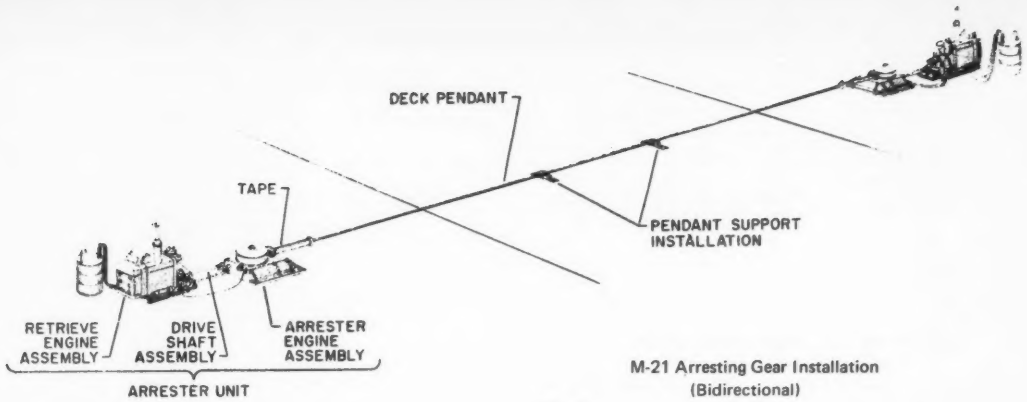


Fig. 2



M-21 Arresting Gear Installation (Bidirectional)

Fig. 3

opposite end of the crossdeck pendant.

E-28 Rotary Hydraulic Arresting Gear. The E-28 arresting gear is bidirectional installation capable of arresting tailhook-equipped aircraft ranging up to 78,000 pounds in weight (see Fig. 4 on next page). Engagement can be made from either runway direction at a distance up to 40 feet off center from the runway centerline. Operation of the arresting gear is entirely automatic.

The E-28 arresting gear installation consists of two arresting engines installed above deck on opposite sides of the runway and each operating a single nylon tape. They are rotary hydraulic energy absorbers and are designed to jointly dissipate the kinetic energy of a landing aircraft or an aircraft aborting a takeoff.

When the aircraft's tailhook engages the crossdeck pendant, the attached purchase tapes are pulled out of a drum on each arresting gear. Each drum is splined to a shaft which turns a vaned rotor between vaned stators in a housing filled with fluid. The ensuing fluid turbulence converts the aircraft's kinetic energy into heat, decelerating the aircraft smoothly to a stop.

M-21 Expeditionary Aircraft Recovery System. The M-21 is a bidirectional expeditionary recovery system designed for use in Short Airfield for Tactical Support (SATS) applications (see Fig. 3). It consists of an arrester engine assembly (energy absorber) located on each side of the runway and attached to a tape wound on each arrester engine tape reel. It is designed for use by tailhook-equipped aircraft.

Arrestment depends upon the ability of the energy absorber unit to gradually stop the unwinding of the tape. The energy absorber unit is similar to that of E-28 gear.

The installed M-21 recovery system uses an area 175 feet by 1,600 feet and provides for recovery of aircraft from either direction. The intended use of the M-21 system is to provide the rapid-cycle recovery (by arrestment) of aircraft landing on a SATS or other expeditionary airfield. The maximum energy-absorbing capacity is 56,000 foot-pounds, aircraft weight range is 10,000-80,000 pounds, and maximum engaging speed is 150 knots. M-21 recovery operations were designed specifically for Marine Corps aircraft operations in

Aircraft Recovery Bulletins on Field Arresting Gear

The tabulation below relates current ARBs to the various types of field arresting gear. Pilots and other operations personnel should be familiar with the contents of applicable ARBs for the most effective use of field arresting gear, particularly as they pertain to engagement speeds, weights, and limits of off-center engagement.

ARB Application	Applicable ARB
E-5 and E-5 Mod 1 Emergency Arresting Gear (150 to 500-foot span)	47-12G
E-15 and E-15 Mod 1 Arresting Gear (300-foot span)	44-12G
E-15 and E-15 Mod 1 Arresting gear (200-foot span)	48-12F
E-27 Arresting Gear (200 to 310-foot span)	43-12J
E-28 Arresting Gear (225-foot span)	46-12G
M-21 Arresting Gear	45-12F

Chart 2

U. S. Navy/Marine Corps Shorebased Arresting Gear

Arresting Gear	No. of Systems Installed, 4/30/81	Arrestments in CY: 1977	1978	1979	1980
E-5/MA-1A	122	11	14	12	8
E-15/E-15-1	3*	86	91	57	12
E-27/E-27-1	4*	8	11	24	15
E-28	193**	3,752	4,718	4,297	4,633
M-21	13+	4,634	6,017	6,728	4,186
	Totals	8,491	10,851	11,118	8,854

* Number of systems installed is decreasing.
** Number of systems installed is increasing.
\+ These are current installations; however, there are 75½ systems that are currently supported and capable of being installed.

Chart 3

forward areas.

Chart 2 provides a list of Aircraft Recovery Bulletins pertinent to current field arresting gear.

Chart 3 is a compilation of arrested landings made in the various types of arresting gear systems in use at Navy and Marine Corps airfields over the past 4 years. The high number of arrested landings made into M-21 gear (SATS) can be attributed to the training which Marine Corps pilots receive in preparation for operating with the SATS gear in forward areas where Marine aviation units can be deployed. This training stresses the capability of being able to operate tactical jet aircraft from areas where standard length runways are not available.

The use of arresting gear today is not always considered to be an "emergency" as it was in the early years of its use. The only system still referred to as "emergency" arresting gear is the E-5/MA-1A chain type. Many squadrons have incorporated into their SOP the requirement to make an arrested landing under certain routine conditions, e.g., an A-7 landing on a wet runway.

A compilation of arrested landings for 1980 by aircraft model is listed in Chart 4.

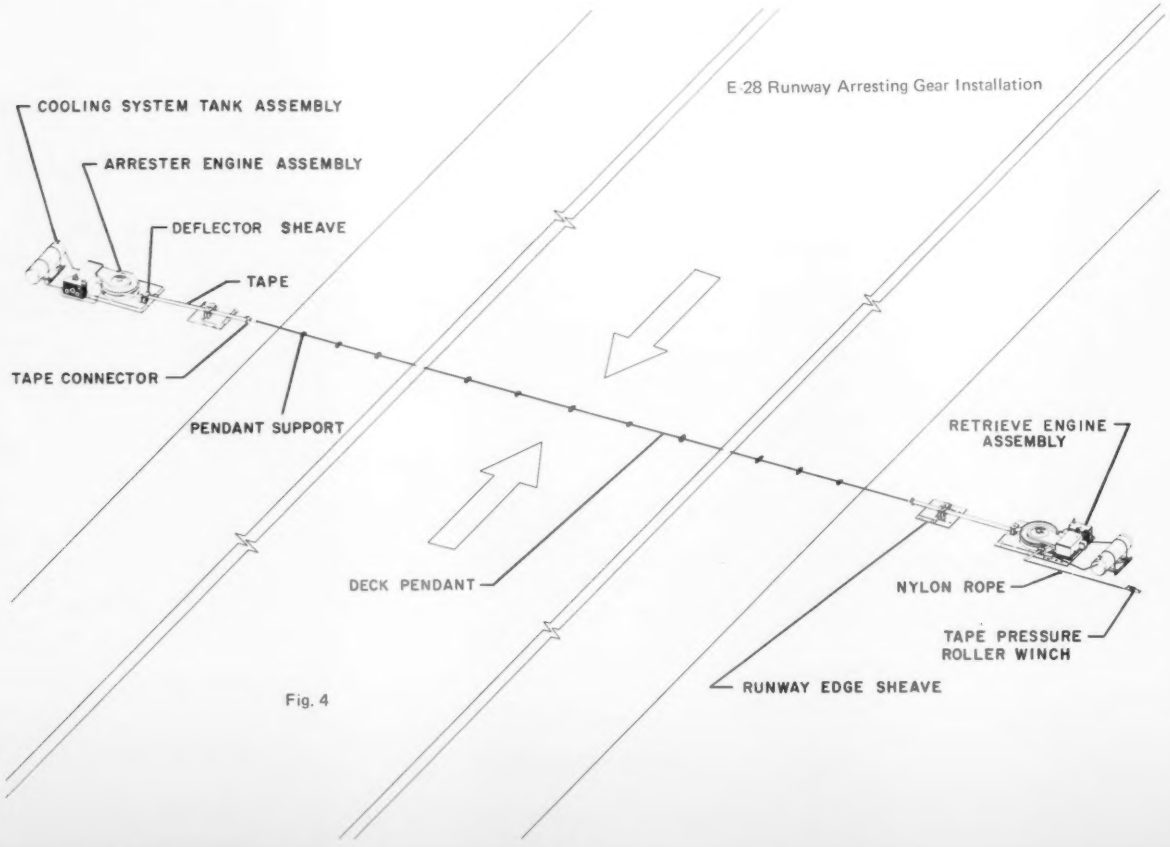


Fig. 4

CY 1980 Arrestments By Aircraft Type

Aircraft	Arrestments (Less M-21)	M-21	Total
A-3	57		57
A-4	1148	321	1469
A-6	256	308	564
A-7	1985	6	1991
C-1	28		28
C-2	5		5
E-2	55		55
F-4	658	3551	4209
F-8	29		29
F-14	126		126
F-15	2		2
F-18	5		5
S-2	4		4
S-3	216		216
T-2	94		94
Totals	4668	4186	8854

Chart 4

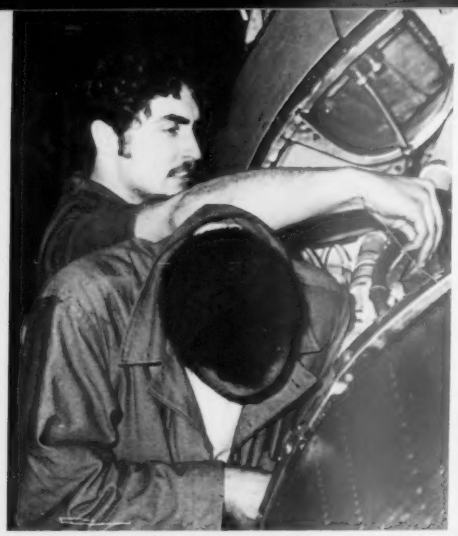
Whether your airfield arrestments are made under routine or emergency conditions, the better you understand the equipment, the better chance you have of completing a safe landing. This article has enumerated some basic facts of field arresting gear, but it is up to you to research the applicable Aircraft Recovery Bulletins and other pertinent sources for information on the types of gear you most often use. ◄

Airshow Aftermath

AS part of an open house at an overseas air station, arrangements had been made to include a large static display of both domestic and U. S. Armed Forces aircraft. As anticipated, the local populace turned out in force to snap photos and take in the sights. A NOTAM had been published for closing the runway, and the spectators were allowed free access to both the display and the picnic area across the inactive runway. All was festive and safe until 1530 when a crash crew truck began broadcasting (in English) that, "The static display is now secured." Simultaneously, tow tractors materialized, starting units were attached to the numerous nonresident aircraft, and rotors, props, and jet engines started turning! The entire evolution took place with hundreds of people still surrounding the aircraft on the parking mat.

The more sensible spectators quickly covered their ears and headed back across the runway toward the picnic area but were stopped by the crash crew and MPs at the very edge of the now active runway. The crowd was allowed to remain and watch as the aircraft on takeoff roll rushed by them only a few feet away. Miraculously, no one was injured, but even an inactive imagination can run wild thinking about the possibility of just a single aircraft developing a control malfunction and departing the runway through that crowd.

After all the guidance expressed in message traffic and in safety articles (APPROACH/NOV '80) concerning safety during spectator events, we were appalled by this unprofessional and downright dangerous performance. This hazard could easily have been eliminated by simply holding the visiting aircraft overnight – or at least until visitors to the open house had departed.



By AW1 David R. Tedford
HS-74

SAFETY:

Scenario: Petty officer's assignment as a reserve squadron safety petty officer for HS-74.

Operations Officer: Well, Petty Officer Jackson, congratulations on your new assignment as the squadron safety petty officer. The commanding officer and I concurred that you are the right man for the job. Operations will miss you, but the Maintenance Department can't afford to release an individual to fill the billet. I'm sure you'll be able to adapt and do an outstanding job. Now don't forget us. Let us hear from you every now and then.

Petty Officer Jackson: Well, uhhh, gee, thank you, sir. (Confused and in a state of semishock and bewilderment, he is privately thinking "What in the world is a squadron safety petty officer, and how did I get suckered into this assignment? I sure must have made someone mad.")

Elapsed Time: Two minutes.

That conversation took place approximately 12 months ago, and I'm still adapting to the routine of the job. I am still learning what a safety petty officer is, what is expected of him, and most importantly, what he isn't.

It is because of this ongoing experience that I can see the need for not only a squadron safety petty officer but a definite need for an Aviation Safety Petty Officer School. It is to this end that I make this attempt to prove a point for "aviation safety." Without the experience of schooling, the squadron safety petty officer is handicapped from the beginning! This applies equally to active duty squadrons as well as reserve squadrons.

In a reserve squadron, a squadron safety petty officer with no other duties is crucial for an effective, ongoing safety program. During the majority of the unit's operating days, he is the only on-scene representative of the Safety

fact or fiction?

Department. He becomes the acting department head, ASO, NATOPS, and ground safety officer, representing their policies and programs throughout the month between scheduled drill weekends. His duties may include, but are not limited to, the following:

- Update and promote squadron safety programs, with emphasis on maintenance, ground safety, aviation safety, traffic safety, and general on/off duty safety.
- Chair the Enlisted/Maintenance Aviation Safety Committee and maintain and distribute the minutes.
- Maintain high visibility and familiarity in all working spaces, promote hazard awareness, and gain an overall view of safety attitudes, practices, and conditions in the daily routine.
- Maintain a passdown log for all Safety Department officers as a central point of communications and a record of progress in the overall safety program.
- Maintain a file of safety publications, notes, instructions, messages, and correspondence for distribution. These will include safety posters for bulletin boards.
- Maintain directives and forms needed to ensure submission of all required safety reports.

For the purpose of brevity, I will not include the 54 specific duties listed in my billet description.

The squadron safety petty officer's effectiveness is gauged by the lack of Mishap Reports. The major question I ask is: How can you expect a safety petty officer, thrown into this field without the proper tools (i.e., training and education), to do an effective job?

Ahhh, now I remember – that old standby – O.J.T. Now, everyone knows that, in the Navy, mountains can be moved (along with aircraft) and accidents prevented through O.J.T. This is quite apparent from the list of safety messages I receive each day of the week. Well, if this is your solution, then what is the effectiveness of your safety program while your new safety petty officer is learning?

Darn, I forgot all about the aviation safety officer who has been to school. I'm sure that he handles all the day-to-day safety-related functions of your command. In a reserve squadron, we all know that of the five permanently assigned officers, at least one is assigned as the safety officer. Unfortunately, this is not the case. They will *assist* until the reserve safety officer comes in on his drill weekend, and we all know that accidents will wait until he shows up because he is trained to handle all mishaps.

To all commanding officers and O-in-Cs, I offer seven questions which you can use as a guide for selecting a successful squadron safety petty officer. (These seven questions are by no means the definitive solutions to an effective safety program.)

1. What is 4790.2B?
2. What is 3750.6M?
3. What does the NATOPS Manual your squadron uses mean to your safety petty officer?
4. What is a safety report and to what purpose is it used?
5. Are Mishap Reports watered down so we will not look bad in front of God, CAG, and the rest of the world?
6. What is an Enlisted/Maintenance Aviation Safety Committee?
7. Do I (your commanding officer/O-in-C) take an active or passive part in disregarding or concurring in the opinions or suggestions offered by the Enlisted/Maintenance Aviation Safety Committee?

If your prospective squadron safety petty officer cannot answer six of these questions satisfactorily, with the assistance of the commanding officer/O-in-C, then I suggest that your squadron is in trouble. If the same prospective squadron safety petty officer, with the same assistance, cannot answer five of these questions satisfactorily, I suggest your squadron have a working knowledge of SGLI benefits and CACO duties.

We all realize that *APPROACH, MECH,* and *NAVY LIFELINE* magazines support the philosophies and attitudes of the Naval Safety Center. They preach and promote "safety" as a dominant theme. But where is the support for a safety petty officer's school? Maybe I'm a little late in assuming that no one cares, except for a few disgruntled, bleary-eyed, haggard-looking safety petty officers. I can hardly wait for the first reaction. I'm almost assured that it will mention the lack of funds and that, although it seems to be a viable program, the Navy just can't afford it at this time.

Well, I suggest that we can't afford not to afford it. What is the price tag for one of our squadron personnel? ◄

"Lost Comm" made simple

By LCDR Brad Hawkins, Jr.
VF-43

EVEN though modern technology has greatly decreased the chances of two-way communications failures, "lost comm" is still a distinct possibility. As in all other flight evolutions, there are published procedures to cope with this problem. "Lost comm" procedures are covered by the FAA in the Emergency Procedures Chapter (Chapter 5) of the Airman's Information Manual and by the Department of Defense in the Emergency Procedures Section (Section E1) of the FLIP IFR Supplement. Many of the procedures overlap and can be confusing. Having served as the Instrument Phase Officer at VF-43, I will try to simplify and summarize the procedures contained in these two publications and FAA Regulations concerning "Lost Comm" while operating under Instrument Flight Rules (IFR).

It is virtually impossible to provide regulations and procedures applicable to all possible situations associated with a two-way radio communications failure. When confronted by a situation not covered by regulations, aircrews are expected to exercise good judgment in whatever action they elect to take. Should the situation so dictate, they should not be reluctant to use emergency action to the extent necessary.

While operating under IFR there are two flight conditions in which you may find yourself: Visual Meteorological Conditions (VMC) or Instrument Meteorological Conditions (IMC). The procedures in the event of "lost comm" are different for each. In either condition, however, the questions that should be considered are the same: (1) Where do I go? (2) At what altitude? (3) What do I do when I get there? To use the VMC procedures you must be in VMC and be able to maintain VMC until you land. Use the IMC procedures if you are in IMC or if you are in VMC but IMC will be encountered on descent. The procedures in IMC depend upon whether you are en route or on a turbojet en route descent.

If you have a communications failure, it will usually occur when switching from one frequency to another. First, you must determine if you really are "lost comm." Switch back to the last good frequency. If unable to establish communications, switch to the sector frequency listed in the IFR Enroute Supplement for your location. Next, try to contact FSS on 255.4 or the published VHF frequency. As a last resort, use the Guard frequency (121.5 MHz VHF or 243.0 MHz UHF). If all of this does not work, you have lost two-way radio communications. The first thing to do is squawk mode 3/A, code 7700, for 1 minute and then mode 3/A, code 7600. Repeat this cycle every 15 minutes. Figure 1 is a summary of the procedures to be followed after determining you are "lost comm."

In order to use Fig. 1, first determine your flight condition: VMC, IMC en route, or IMC on a turbojet en route descent. In a "lost comm" situation, you are on an en route descent if you have requested an en route descent, vacated your cruising altitude, and have been cleared to an altitude below the highest Initial Approach Fix (IAF) altitude for the destination airport. Next, go to the section for your condition and follow the guidelines for route, altitude, and what to do upon arrival at the IAF. If you received a short range clearance limit before losing communications, comply with the procedures in Section IV. Then continue with the procedures in Section II.

Courses of action are given in order of priority. For example, you are in the middle of a routine cross-country at FL290 and in IMC when you lose two-way radio communications. Go to Section II of Fig. 1. Your route of flight will be the last assigned route including all proposed further routing. If, by chance, you were given a short range clearance limit, you would proceed via the flight plan route after the clearance limit. If the clearance limit is off your original route of flight and you neglected to request proposed further routing, proceed after the clearance limit via the most direct route to intercept the flight plan route and then continue via the flight plan route. The altitude at which you would proceed will be the last assigned altitude including all proposed climbs or descents, but in no case lower than the Minimum Enroute Altitude (MEA). If you arrive at the IAF *before* your Estimated Time of Arrival (ETA), enter holding, be at the IAF at your ETA, and commence the approach. If you arrive at the IAF *after* or *on* your ETA, commence the approach upon arrival. If you are too high to safely execute the approach, let down in holding at the IAF after the ETA/EAC (Expected Approach Clearance Time), and then commence the approach.

There is always a question about what to do at those 10 airports in the United States that have an IAF that is not located within the published holding pattern. NAS Pensacola is a good example. Mary (NPA 180/11) is the holding fix with published holding at Mary. The IAF (NPA 212/14) for the HI-TACAN RWY 7R is not located in the holding pattern. The rules in Fig. 1 still apply. If you have not been cleared to Mary for holding by ATC you would proceed to the IAF as filed and enter holding there until the ETA and commence the approach. If you have been cleared to hold at Mary and have been given an EAC, enter holding at Mary. Depart Mary to arrive at the IAF at the EAC and commence the approach. In either case, if too high, descend in holding at the IAF after the ETA/EAC.

That's all there is to it! Squawk 7700/7600 and decide what situation applies: VMC, IMC en route, or IMC turbojet en route descent. Consult Fig. 1 for route, altitude, arrival, and holding procedures. Comply with the procedures. Figure 1 has been displayed to facilitate local reproduction for use of all aircrews. ◄

LOST COMM PROCEDURES

Route	Altitude	Arrival
I. VMC		
A. Your choice to a suitable field	A. Any VFR altitude below PCA (18,000)	A. Land as soon as practicable
II. IMC En route		
A. Last assigned B. Proposed further routing C. Flight Plan route	A. Last assigned B. Proposed climbs or descents C. Not lower than MEA	A. *Early* 1. Hold at the IAF in published holding pattern or standard pattern if not depicted 2. Arrive at the IAF at ETA/EAC and commence B. *On time or late* 1. Commence upon arrival C. *Too high to commence* 1. Descend in holding at the IAF after ETA/EAC and commence from the IAF
III. IMC Turbojet En route Descent		
A. Direct to the IAF	A. *Outside 25 nm* Last assigned or Emergency safe, whichever higher B. *Inside 25 nm* Last assigned or Minimum safe, whichever higher C. *After intercepting altitude profile of approach* As published	A. Penetrate upon arrival at the IAF B. If too high to commence, descend in holding at the IAF and commence from the IAF

IV. IMC En route Holding at a Clearance Limit

A. No EFC – Do not enter holding; proceed, complying with IMC En route procedures

B. With EFC – Leave the holding fix at the EFC and proceed, complying with IMC En route procedures

C. With EAC – Leave the holding fix to arrive over the IAF at the EAC and commence

NOTE: All situations – Squawk Code 7700 for 1 minute, then code 7600. Repeat this cycle every 15 minutes

Fig. 1

BETTING

By Joseph F. Tilson
USAF Structural Engineer

BREATHES there a group of fighter pilots gathered where the conversation doesn't get around to the last rat race where??? Let's finish that with some words we've heard too frequently of late: "I was pulling on the pole for 7.2G and then I hit his jetwash and rang up a 9.0 on the meter."

"That's okay, those birds are designed to take a lot more than that!"

As a pilot and an engineer, I am bothered by that sort of conversation. I wonder how such a conclusion is reached. It seems to come about for two reasons. First, everyone knows about the guy who pulled 12G and still stayed in the air. Second, some of the jocks who are a bit more technically knowledgeable have taken the trouble to explain to those less knowledgeable that the *structural design engineer put a 50 percent margin of safety into the design.* The last part is the kicker, and I'd like to talk about that *margin of safety.*

Yes, structural designers do use a 50 percent cushion, but it is darned important that all of you WBFPs* understand just how this 50 percent figure is arrived at and how it is divided up. One way to look at it is as sort of a nonreplenishable rainy day emergency fund set aside years ago. One day you decide to use it and find that it is gone. When you ask your spouse where the money went, she says, "I never took more than $5 at a time!" A reasonable approach, perhaps, but irrelevant to the intended purpose.

Before we talk too much about the margin of safety, we need to have a mutual understanding of a couple of engineering terms:

Limit Load: The highest load the pilot is normally expected to impose. (You can exceed it, but when you do, some part of the bird may be permanently deformed. It can no longer be considered "like new.")

Ultimate Load: The load point expected to cause complete fracture of some part of your aircraft. (This usually is the point at which you and your bird will part company.)

The designer tries to assure the ultimate load is 50 percent above the limit load. There are several reasons why he does this, but the most important thing for you to remember is: **he did not do it to give you a 50 percent cushion to work with!** He knows that there will be *some* intentional and some accidental overshoot when the going gets hot and you start really honking it around up there. Part of the 50 percent margin of safety is budgeted for that sort of thing. Still, there are many other claimants for a share of the pie before you ever get to strap on the bird. Some of the real world things that eat away at the 50 percent include:

**World's best fighter pilots*

THE 50

- Misdrilling of critical fastener holes.
- Tool nicks at critical fastener points.
- Improperly heat-treated metal in structure or fasteners.
- Corrosion paths opened by damage to protective coatings.
- Internal (not inspectable) corrosion cracking.
- Improperly torqued fasteners.
- Structural damage induced by bending and stretching. (You know, that other jock that pulled the 12G and got away with it.)
- Fatigue induced by excessive high-G counts.

The list is by no means complete. It could go on and on. I participated in one mishap investigation where our analysis showed the actual designed margin of safety was only 23 percent. Given the usual wear and tear, the bird failed even though the pilot at the time was operating within prescribed limits.

Let me explain something else about the structural designer. His fondest dreams are realized when his airplane is put through a static loads test and two things happen. First, the bird reaches *limit load* without any permanent deformation after the load is released. And second (now pay attention you guys who frequently bet on that 50 percent), the aircraft falls apart catastrophically when the load reaches 1 percent past *ultimate load* (1.5 x limit load)!

Why, you ask, does he cut it so close? Well, the reason is those were the specifications he was given to design. If he actually achieved a 60 percent margin of safety (1.60 x limit load), odds are that you are going to carry around 10 percent more weight than you need. One of the best ways a designer can give you high performance is to keep aircraft weight to a minimum. Just in case, at this point, you're thinking of the new lightweight, high-strength materials now available, rest assured the designer uses them also, but he still keeps weight to a minimum for a given required strength! Now, what do you think about that?

No matter how you cut it, if you are one of those who bet on that 50 percent being there for you personally to use, you are making a sucker bet. If you and your fellow jocks take good care of your bird, chances are your margin of safety will be there when you really are closing in for a kill and you need to reach down for just a little more. But if you insist on spending your emergency fund a little at a time, day after day, when you really don't need to, I suggest you take your money to Las Vegas. The odds are better there! ◄

Reprinted from AEROSPACE SAFETY. The author was a naval aviator from 1952 to 1962 and served in VMF-312 and VMF-241.

OVER-G AND THEE

By Joseph F. Tilson
USAF Structural Engineer

If I were a flea and I could be
On the neck of a pilot during over-G

I'd shake my head and say "that's nifty"
You didn't read my article, "Betting the Fifty"

Now, engineers are a funny breed
A calculator is their trusty steed

They designed the craft to the specs you stated
But your thirst for G goes unabated

"Train as we fight," the fighter jocks cry
"But," says the engineer, "so may you die"

As spoken before, we're a funny breed
Design integrity is our creed

We want your bird to have reliance
But we didn't invent the structural science

You pushed it too far once too often
And as you were told, the wings did soften

"Engineers don't have the big picture" it's said,
But from here we can see you surely are dead

SEA KNIGHT SYNDROME

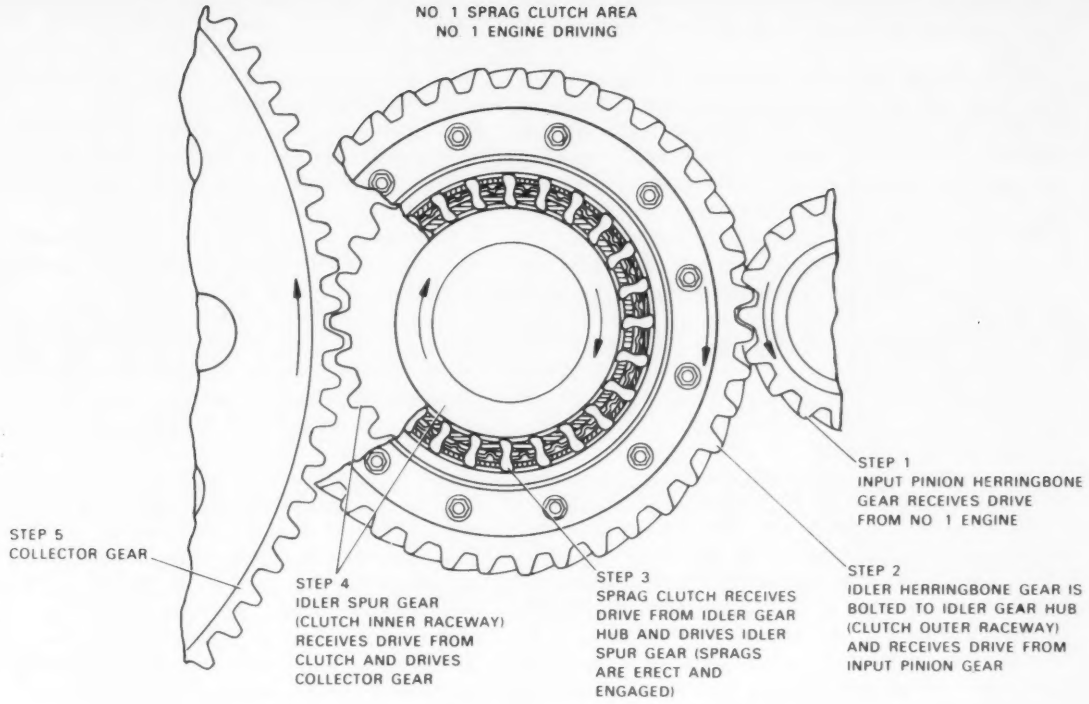
By Maj Jack P. Cress, USMC
Aviation Safety Programs
Naval Postgraduate School

You are wrapped up at 45 degrees in a turn at constant power. The mission has you down close to the deck – nap-of-the-earth. At low forward speed on the back side of the power curve, with a belly full of troops on this hot afternoon, you hear a change in engine/rotor noise level. Your eyes note the cacti looming large on the desert floor as you roll your helo wings level, flare, and get a quick look at the instruments while you search frantically for a spot to put her down. The RAD ALT warning illuminates as you pass through 50 feet AGL. Turns are 94 percent and falling . . . sure sounds like a simple case of an engine failure, doesn't it? Getting it on the deck without a crunch won't be so simple, however, particularly under these conditions. No time for a relight attempt and hardly time to let the crew in on what's happening and get your harness locked . . .

THOSE H-46 drivers among you who are reading this in the unfazzled quietude of your office or stateroom are saying "Whoa! Who says we've got an engine failure? What did that fellow who was skillfully monitoring the gages in the other seat see on the instrument panel?" If I told you he saw one N_f split high (above the drooping N_r and N_f of the unaffected engine) and if I told you affected engine torque had dropped to near zero with its T_5 down around 400 degrees Centigrade and affected N_g not much above ground idle (even though the collective was in the armpit), you'd say we have a simple sickness called sprag clutch slippage. If you've read your H-46 NATOPS recently, however, you've seen some words back around page 5-15 which indicate that slippage only occurs after recovering from a split needle condition, i.e., autorotation (where N_r overruns N_f). If you've been reading the message traffic of late, you know "it ain't so."

Let's look at some specific cases (least hair-raising first):

- During turnup of an E Model in November 1980, pilot noted No. 1 N_f split 11 percent above No. 2 N_f/N_r following rotor engagement. Three attempts to reengage the No. 1 sprag were unsuccessful.
- The same squadron had a similar occurrence on a turnup within a few days of the one previously mentioned with no reengagement after five attempts. (By the way, the gearbox had only 9.7 hours on it since both clutches were replaced at depot due to high-frequency vibration in the input pinion area.)
- Over the past year, two other cases of slippage occurred during or shortly after engagement, the most interesting of


NO 1 SPRAG CLUTCH AREA
NO 1 ENGINE DRIVING
STEP 1
INPUT PINION HERRINGBONE
GEAR RECEIVES DRIVE
FROM NO 1 ENGINE
STEP 2
IDLER HERRINGBONE GEAR IS
BOLTED TO IDLER GEAR HUB
(CLUTCH OUTER RACEWAY)
AND RECEIVES DRIVE FROM
INPUT PINION GEAR
STEP 3
SPRAG CLUTCH RECEIVES
DRIVE FROM IDLER GEAR
HUB AND DRIVES IDLER
SPUR GEAR (SPRAGS
ARE ERECT AND
ENGAGED)
STEP 4
IDLER SPUR GEAR
(CLUTCH INNER RACEWAY)
RECEIVES DRIVE FROM
CLUTCH AND DRIVES
COLLECTOR GEAR
STEP 5
COLLECTOR GEAR

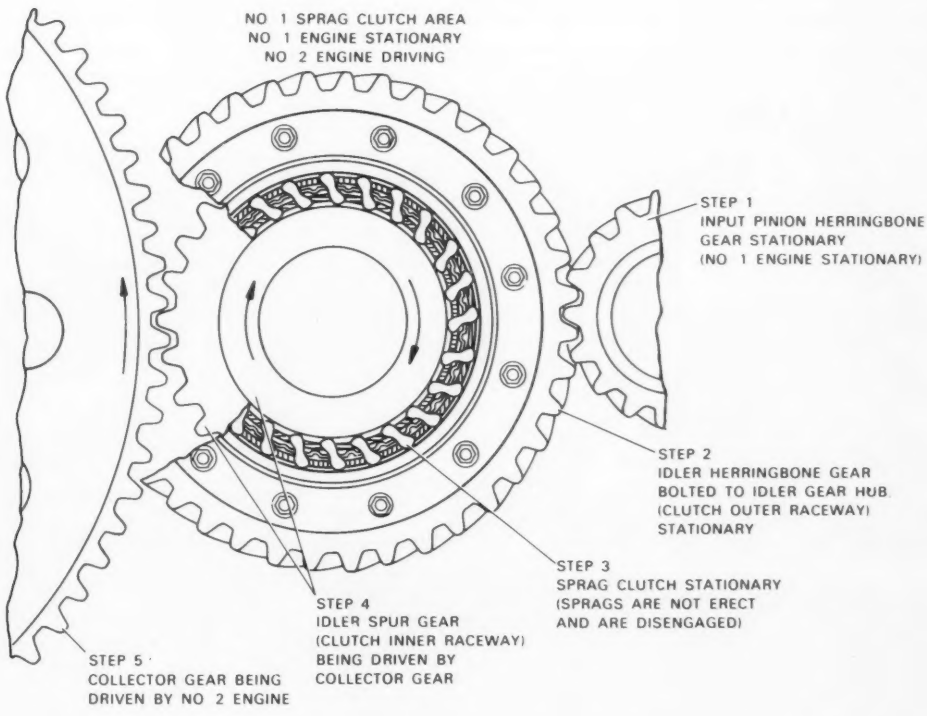

NO 1 SPRAG CLUTCH AREA
NO 1 ENGINE STATIONARY
NO 2 ENGINE DRIVING
STEP 1
INPUT PINION HERRINGBONE
GEAR STATIONARY
(NO 1 ENGINE STATIONARY)
STEP 2
IDLER HERRINGBONE GEAR
BOLTED TO IDLER GEAR HUB
(CLUTCH OUTER RACEWAY)
STATIONARY
STEP 3
SPRAG CLUTCH STATIONARY
(SPRAGS ARE NOT ERECT
AND ARE DISENGAGED)
STEP 4
IDLER SPUR GEAR
(CLUTCH INNER RACEWAY)
BEING DRIVEN BY
COLLECTOR GEAR
STEP 5
COLLECTOR GEAR BEING
DRIVEN BY NO 2 ENGINE

Fig. 1

which occurred aboard ship after a routine check of the overspeed protection system (activation of No. 2 overspeed test switch).

- Also in the past year, there have been at least four cases where sprag clutches have slipped during power application on final after approaches which involved no split needle descents. While successful recovery from this "single-engine" condition was effected in each case, one involved a heavy, E Model landing in a tactical zone. Only a good measure of pilot skill and a single-engine gearbox overtorque prevented a crash.
- Over this same 365-day period, we have experienced two "common" sprag slippages at power recovery following an autorotation.
- One other aircraft suffered a slippage while maneuvering low level and low speed at constant power, necessitating use of the emergency throttle and a single-engine precautionary landing.
- How about the unit which had experienced a No. 2 engine flameout problem and changed the engine only to have the new engine flame out as well! While troubleshooting in a hover (under controlled conditions and with the assistance of a knowledgeable rep), a rapid power application caused not only the No. 2 clutch to slip but No. 1 as well. Due to the sudden release of load on the engines when the slippage occurred, the mechanical overspeed sensing systems "stop-cocked" both engine fuel supplies. Relight did not occur once power turbine speed decayed, but a successful hovering autorotation from about 20 feet was accomplished.

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- In November 1980, the pilot of *dash four* in a flight of four noted unfavorable terrain at the intended point of landing in the final stages of what had been a very normal approach. He instructed the copilot not to land but to hover over the spot. As power was applied, the HAC heard an "unwinding" in the headset and noted simultaneous settling of the aircraft. He immediately took control and punched the emergency throttle – to no avail. Turns drooped to 60 percent as the aircraft settled onto the sloping terrain below and rolled over. Thankfully, only *Charlie* damage and *Golf* injuries resulted.

By now you've heard enough of sprag clutches gone wrong. The questions "Why?" and "What do we do?" now need some answers. As to "Why?", the answers are many:

- The "old" clutch slips because the teeth fail to erect and thereby allow transmission of power (see Fig. 1). Or the teeth/race are undersized/oversized and "rollover" of the clutch elements can occur under transient power application or sustained high power application.
- In an effort to save some money in the expensive process of overhauling clutches at the depot level, we tried to reuse or replace parts from one clutch to another. It didn't work very well.
- Some sizing errors at the depot level aggravated the previously known problem with "rollover" or "erection failure" of the teeth.

What do we do? First of all, a good hard look at overhaul methods was necessary in order to improve the reliability of the clutches now on hand. This has been accomplished at the depot level maintenance activities, and problems there are believed to have been solved. Additionally, a new, higher reliability clutch is being procured. But what do the "wrench turners" and pilots do?

Pilots and crewmembers must first look in the NATOPS and MIM and review clutch operation and indications of slippage. They must also remember that a clutch can slip in many conditions, not just in autorotational recovery. We have discussed instances where simple evolutions like a turnup or overspeed test have resulted in slippage. We know that power application at the termination of an approach has been known to result in slippage, as have rapid power changes in hovering flight. Slippages have also been documented in cruise flight at high power without any collective movement. (This can cause sudden loss of load and overspeed. It happens so quickly that the engine(s) might very well flame out without initial instrument indication of a problem, according to the manufacturer.)

In looking back through data on unexplained single- and dual-engine power losses over the past several years, I couldn't help but wonder how many of those might have been slippage induced. It shook me up a bit, as perhaps this article has you. But remember, knowing that a problem exists and knowing its cause is a big part of solving it. Long term solutions to this problem are on the way. The short term solutions are already here, sitting in the cockpits and jump seats of our H-46s.

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Poster idea contributed by CAPT Harold Juhl, USMC, VT-3

No amount of showmanship can ever prove your skill, but one mistake at any time can prove you a fool.

Jet intakes like junk, bolts, nuts, cotter keys, tools, wallets, flashlights, caps, food containers, headsets, and

PEOPLE

...don't be taken in!

Naval Safety Center
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